CORERIVER
Total Solution of MCU

TouchCore370L-QF16IP

Capacitive Touch Sensor Controller

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1 TouchCore370L-QF16IP Overview

1.1 General Description

TouchCore370L-QF16IP is a high-performance Controller for capacitive touch keys. Its engine is an 8-bit 80C51 compatible Processor.

TouchCore370L-QF16IP has three timer/counters, maximum 7 channels of touch sensors, maximum 10 programmable I/O pins, 1 Watchdog timer, POR (Power-On Reset), I2C, and LVD (Low Voltage Detector) as peripherals. In addition, it contains an internal ring oscillator, which can generate the 48 MHz system clock signal instead of a crystal oscillator.

TouchCore370L-QF16IP has its own architecture for fast sensing. With the hardware filter, it provides noise immunity and excellent sensitivity. The firmware algorithm supports smart sensitivity and compensates for changes in the sensitivity due to environmental factors such as temperature and humidity.

To effectively manage power, ***TouchCore370L-QF16IP*** enables low power consumption by using scan interval and clock control methods after last touch.

TouchCore370L-QF16IP operates over the extended -40℃ to +125℃ temperature range, and is available in the 3mm x 3mm, 0.60T, 16-pin QFN package.

1.2 Features

- Capacitive touch key controller
  - Supports up to 7 single-type touch keys
  - Supports scroll bar-type touch keys
  - Supports wheel-type touch keys
- Response Time
  - Initial latency of < 20ms for first touch, subject to configuration
  - Programmable sensing rate for power saving.
- CPU
  - 8-bit Turbo 80C52 Architecture

- 4 Cycles / 1 Machine Cycle
- Instruction Level Compatible with Intel 80C52

◆ Memory
- 12KB Flash
- 512B Internal Aux. RAM
- 256B Internal RAM

◆ Power Supply
- Operating Voltage : +1.8V to +3.6V

◆ Operating Frequency: Max. 48MHz(@3.3V), 16MHz(@2.0V)

◆ 10 Programmable I/O Pins

◆ Communication interfaces
- 1-channel I2C Communication (Master/Slave)

◆ Internal Ring OSC with Calibration function

◆ Supporting ISP/IAP/MDS

◆ 6 Internal Interrupt Sources and 3 External Interrupt Sources

◆ 4 Reset Sources

◆ Power Down Wake-up Sources
- Reset Sources + 3 External Interrupt (Both Levels)
- Watchdog Timer Interrupt

◆ 3 Operating modes : Active, Sleep, Deep Sleep

◆ E.S.D. Protection up to
- 8,000V

◆ Latch-up Protection Up to ±200mA

◆ Package
- 16-QFN (3mm X 3mm, 0.60T)

1.3 Applications

◆ Home appliance: TV, Monitor, Home Theater

◆ Mobile Phones

◆ Portable MP3, MP4

◆ Digital Cameras

◆ Battery power applications

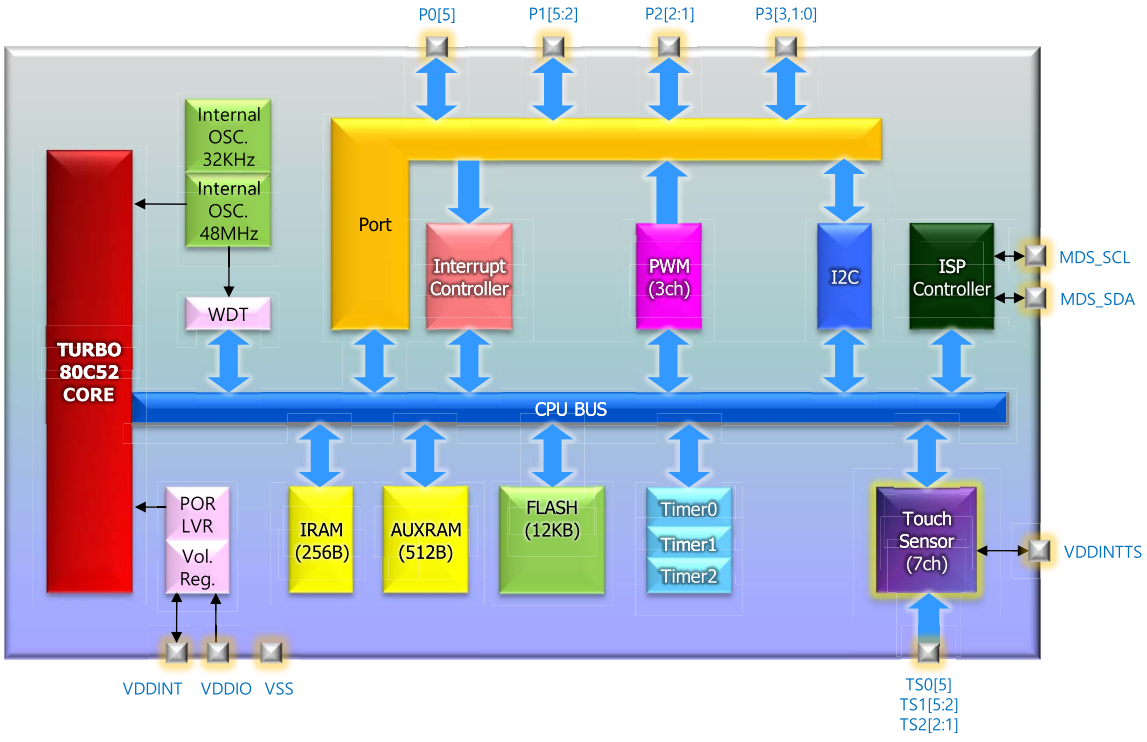
1.4 Product Family Guide

Product	**Res.**	**FLASH** [Byte]	RAM [Byte]	Volt [V]	Freq [MHz]	T/C [16 bits]	COM I/O	WDT	ADC (bit X Ch)	PWM (bit X ch)	I/O Pins	**Touch Channel**	Package	Others
TouchCore370L-QF16IP	65,536	12K	512 + 256	1.8 ~ 3.6	48	3	1 I2C	1	None	8 X 3	10	7	16-QFN (3x3, 0.60T)	IAP ISP EJTAG LVR POR RING

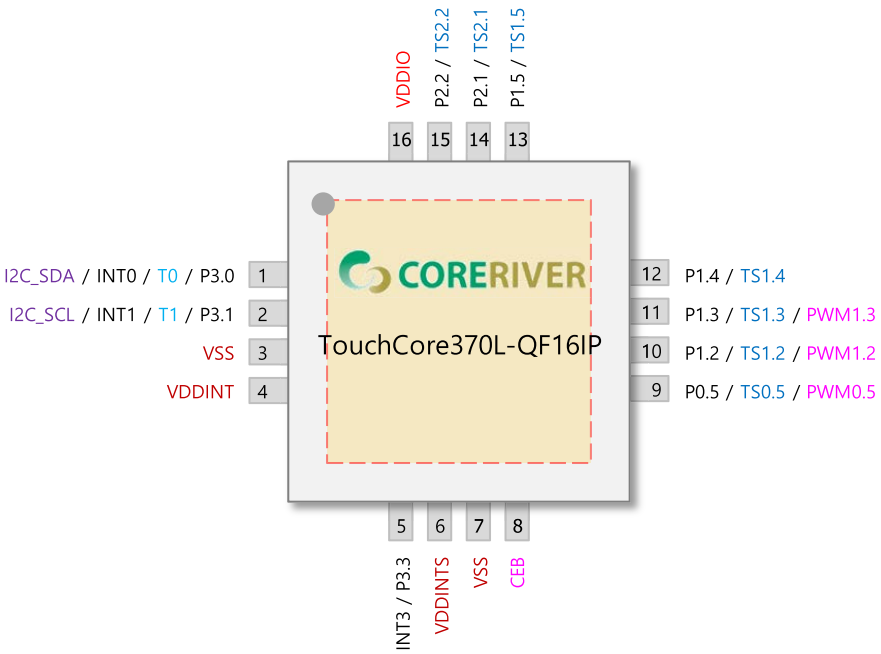
2 Block Diagram

Figure shows the block diagram of ***TouchCore370L-QF16IP***. Programs reside in the internal program memory (Embedded Flash Memory). Data are read from or written to data memory (SRAM) or special function registers (SFRs).

The internal registers of ***TouchCore370L-QF16IP*** are configured as part of the on-chip RAM: therefore each register has an address. This is reasonable for ***TouchCore370L-QF16IP***, since it has so many registers.



3 Pin Configuration



16-pin QFN Package Diagram

4 Pin Description

Pin No.	Name	Type	Description	Share Pins
1	P3.0	I/O	General I/O Port 3.0	I2C_SDA / INT0 / T0
2	P3.1	I/O	General I/O Port 3.1	I2C_SCL / INT1 / T1
3	VSS	GND		
4	VDDINT	O	Digital Power Filter (+1.8V)	
5	P3.3	I/O	General I/O Port 3.3	INT3
6	VDDINTS	O	Touch Sensor Power Filter	
7	VSS	GND		
8	CEB	Input	Chip Enable (Active Low)	
9	TS0.5	I/O	Touch Sensing Channel 0.5	P0.5 / PWM0.5
10	TS1.2	I/O	Touch Sensing Channel 1.2	P1.2 / PWM1.2
11	TS1.3	I/O	Touch Sensing Channel 1.3	P1.3 / PWM1.3
12	TS1.4	I/O	Touch Sensing Channel 1.4	P1.4
13	TS1.5	I/O	Touch Sensing Channel 1.5	P1.5
14	TS2.1	I/O	Touch Sensing Channel 2.1	P2.1
15	TS2.2	I/O	Touch Sensing Channel 2.2	P2.2
16	VDDIO	PWR		

5 Absolute Maximum Ratings

◆ Absolute Maximum Ratings(T_A = 25 °C)

Symbol	Item	Conditions	Range
V_{DD}	DC Voltage in V_{DD} relative to Ground	-	-0.5V to +4.6V
V_{IN}	DC Input Voltage	-	-0.5 V to (V_{DDIO}+0.5V)
V_{OUT}	DC Output Voltage	-	-0.5 V to (V_{DDIO}+0.5V)
I_{OH}	DC Output Current High	One I/O pin active	-25mA
		All I/O pin active	-100mA
I_{OL}	DC Output Current Low	One I/O pin active	+30mA
		All I/O pin active	+150mA
T_{STG}	Storage Temperature	-	-65 °C to +150 °C
T_{SOL}	Soldering Temperature	-	260℃, 10 seconds within 5℃ of actual peak temperature

◆ Recommended Operating Conditions

Symbol	Item	Conditions	Range
V_{DD}	Operating Voltage	-	+1.8V to +3.6V
T_A	Operating Temperature	-	-40 °C to +125 °C

6 DC Characteristics

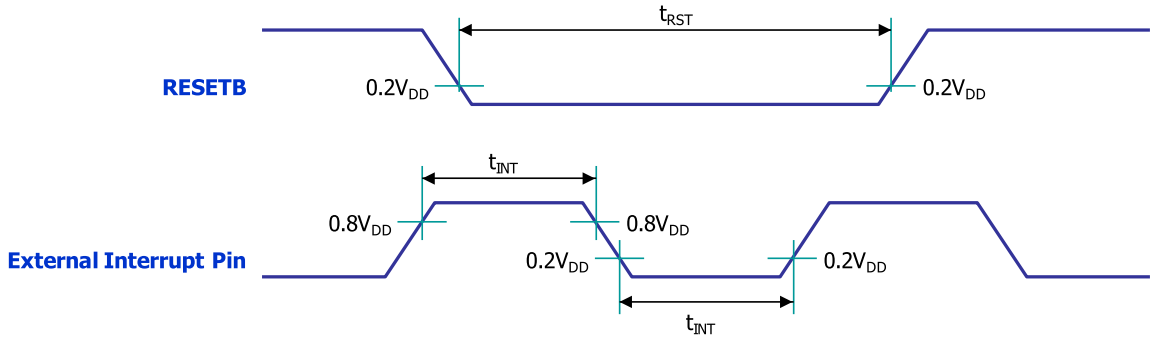
* T_A= -40°C ~ +125°C, V_{DD}=+1.8V ~ +3.6V unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input Low Voltage	V_{IL}	P0,P1,P2,P3	V_{DDIO} = 1.8V~3.6V	-0.5	-	$0.2V_{DDIO}$ -0.1	V
Input high Voltage	V_{IH}	P0,P1,P2,P3	V_{DDIO} = 1.8V~3.6V	$0.2V_{DDIO}$ +1.0	-	V_{DDIO} +0.5	V
Output Low Voltage	V_{OL}	P0,P1,P2,P3	V_{DDIO} = 3.0V~3.6V (I_{OL} = 4.35mA) V_{DDIO} = 1.8V~3.0V (I_{OL} = 3.55mA)	-	-	$0.3V_{DDIO}$	V
		P0,P1,P2,P3[1:0] (High Drive)	V_{DDIO} = 3.0V~3.6V (I_{OL} = 34.79mA) V_{DDIO} = 1.8V~3.0V (I_{OL} = 28.41mA)	-	-	$0.3V_{DDIO}$	V
Output High Voltage	V_{OH}	P0,P1,P2,P3	V_{DDIO} = 3.0V~3.6V (I_{OL} = -8.04mA) V_{DDIO} = 1.8V~3.0V (I_{OL} = -6.62mA)	$0.7V_{DDIO}$	-	-	V
	V_{OHP}	P0,P1,P2,P3 (Pull-up Resistor Only)	V_{DDIO} = 3.0V~3.6V (I_{OL} = -30.30uA) V_{DDIO} = 1.8V~3.0V (I_{OL} = -24.26uA)	$0.7V_{DDIO}$	-	-	V
Logical 1 to 0 Transition Current	I_{TL}	P0,P1,P2,P3	V_{DD} = 3.0V±10% (V_{IN}=2V)	-	-	-650	µA
Input Leakage Current	I_{IL}	P0,P1,P2,P3	V_{IN} = V_{IH} or V_{IL}	-	-	±1	µA
Pin Capacitance	C_{IO}	All	V_{DDIO} = 3.0V	-	10	-	pF

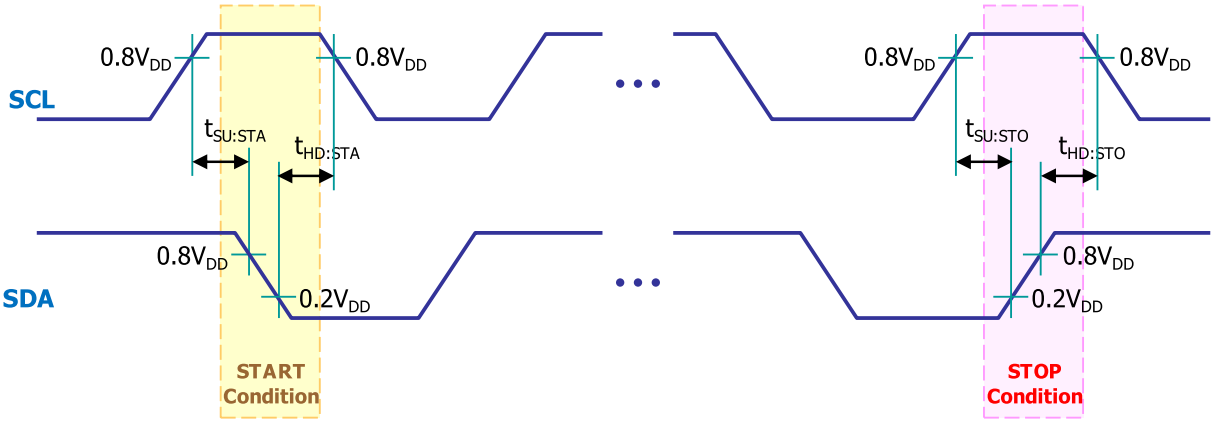
7 AC Characteristics

* T_A = -40 °C ~ +125 °C, V_{DD} = +1.8V ~ +3.6V unless otherwise specified

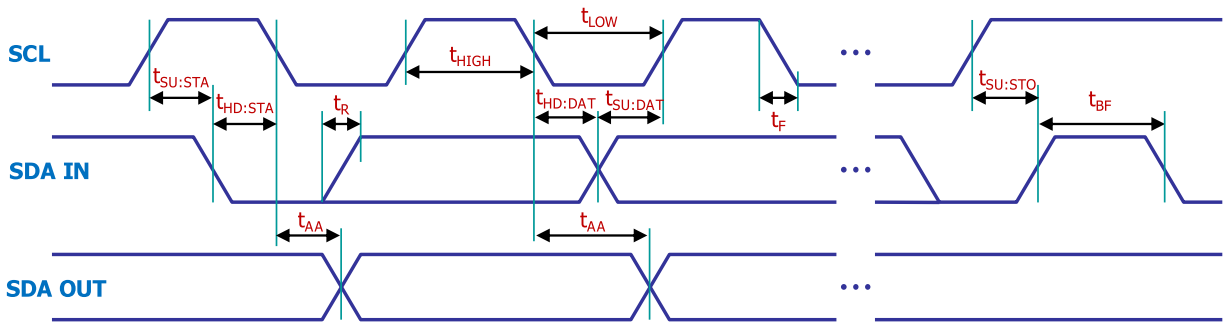
Parameter	Symbol	Pin	Conditions	Value			Unit
				Min	Typ	Max	
RESETB Input Width	t_{RST}	RESETB	V_{DD} = 3V ± 10%	24	-	-	F_{SYS}
External Interrupt Input Width	t_{INT}	External Interrupt	V_{DD} = 3V ± 10%	4	-	-	F_{SYS}



8 I2C Timing Characteristics

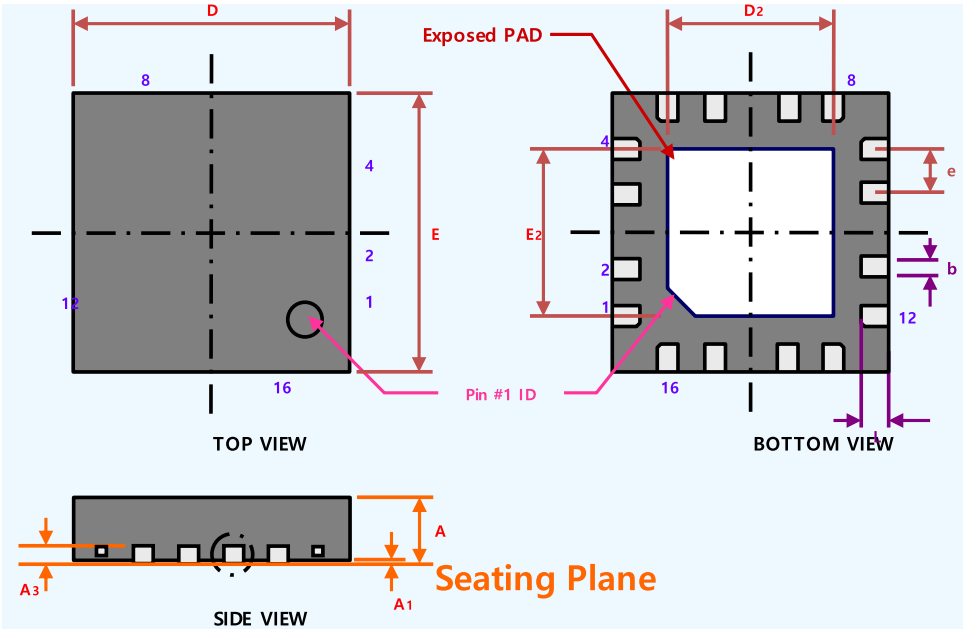


Symbol	Characteristics		Min. [ns]	Max. [ns]	Conditions
$t_{SU:STA}$	START Condition Setup Time	100KHz Mode	4,700	-	Only relevant for repeated START condition
		400KHz Mode	600	-	
$t_{HD:STA}$	START Condition Hold Time	100KHz Mode	4,700	-	After this period, the first clock pulse is generated
		400KHz Mode	600	-	
$t_{SU:STO}$	STOP Condition Setup Time	100KHz Mode	4,700	-	
		400KHz Mode	600	-	
$t_{HD:STO}$	STOP Condition Hold Time	100KHz Mode	4,700	-	
		400KHz Mode	600	-	



Symbol	Characteristics		Min. [ns]	Max. [ns]	Conditions
t_{HIGH}	Clock High Time	100KHz Mode	4,000	-	Minimum Frequency : 1MHz
		400KHz Mode	600	-	Minimum Frequency : 5MHz
t_{LOW}	Clock Low Time	100KHz Mode	4,700	-	Minimum Frequency : 1MHz
		400KHz Mode	1,300	-	Minimum Frequency : 5MHz
$t_{SU:DAT}$	Data Input Setup Time	100KHz Mode	250	-	
		400KHz Mode	100	-	
$t_{HD:DAT}$	Data Input Hold Time	100KHz Mode	0	-	
		400KHz Mode	0	900	
t_{AA}	Data Valid from Clock	100KHz Mode	-	3,500	
		400KHz Mode	-	-	
t_{BF}	BUS Free Time	100KHz Mode	4,700	-	
		400KHz Mode	1,300	-	
t_R	SDA & SCL Rising Time	100KHz Mode	-	1,000	The Range of Cb is from 10pF to 400pF
		400KHz Mode	2.0 + 0.1Cb	300	
t_F	SDA & SCL Falling Time	100KHz Mode	-	300	The Range of Cb is from 10pF to 400pF
		400KHz Mode	2.0 + 0.1Cb	300	

9 16-pin QFN Package Dimension



Symbol	Dimensions [mm]		
	Min.	Nom.	Max.
A	0.55	0.60	0.65
A_1	0.00	0.02	0.05
A_3		0.20 REF	
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D_2	1.40	1.50	1.60
E_2	1.40	1.50	1.60
b	0.18	0.25	0.30
e		0.50 BSC	
L	0.30	0.40	0.50

Notes:

1. All Dimension are in mm. Angles in Degrees.
2. Dimension b applies to Plated Terminal & is measured.
3. BSC : Basic Dimension. Theoretically exact value shown without tolerances.
   REF : Reference Dimension, Usually without tolerance,
   for information purpose only.

TC370L – QF16IP

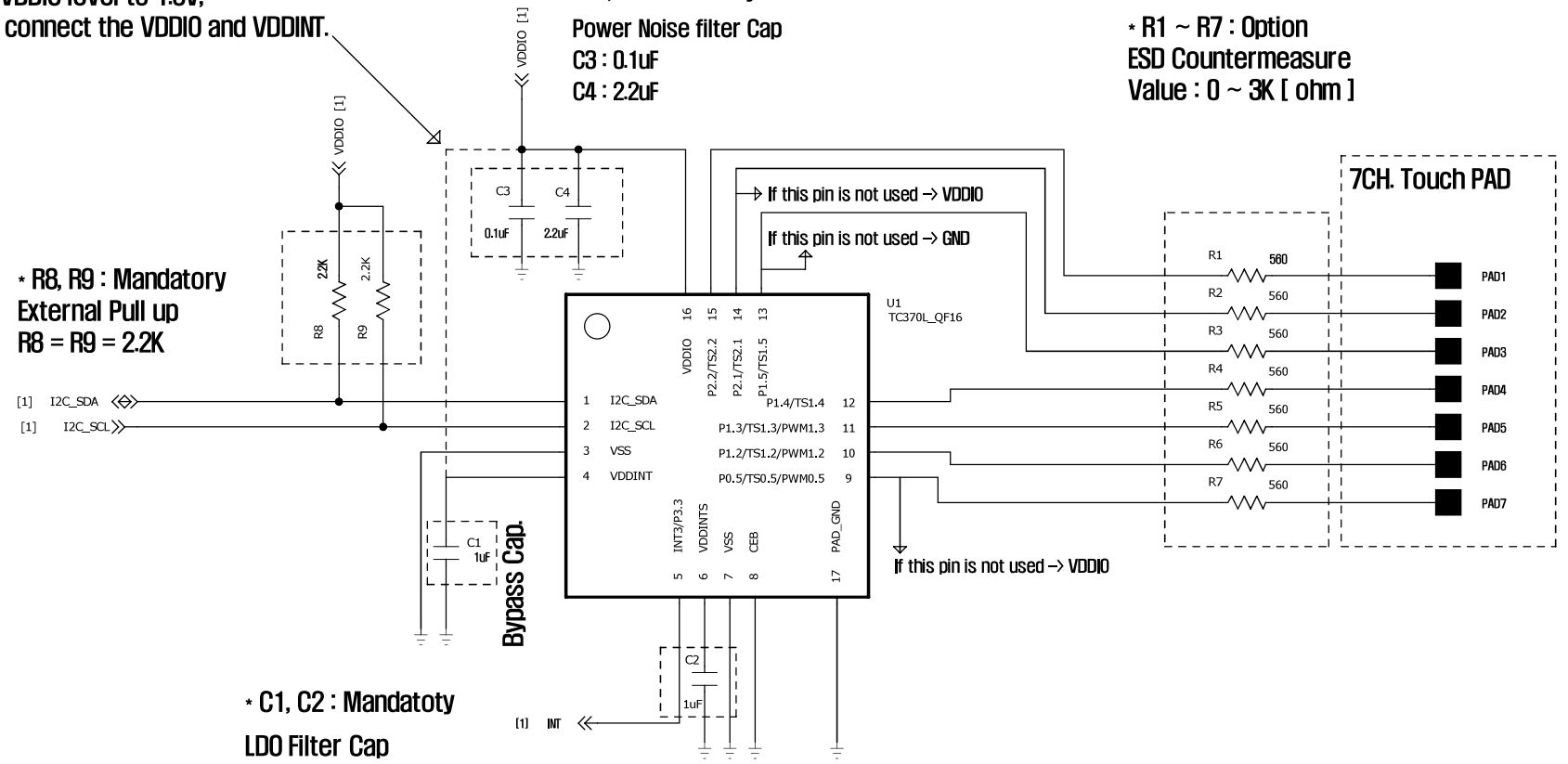
Body Size : 3mm x 3mm

>>VDDIO [Operating Voltage] : +1.8V to +3.6V

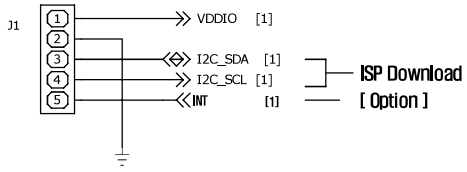
-> If you use the VDDIO level to 1.8V,
you'll need to connect the VDDIO and VDDINT.

* C3, C4 : Mandatory
Power Noise filter Cap
C3 : 0.1uF
C4 : 2.2uF

* R1 ~ R7 : Option
ESD Countermeasure
Value : 0 ~ 3K [ohm]



External interface
ISP Download



NO.	REVISION NO.	NO.	REVISION NO.	C B A	NO	PART NO.	DESCRIPTION	METERIAL	COLOR FINISH	NOTE
1				QUANTITY						
2										

SCALE	UNIT	DRAWN.	D'SCHEMATIC
A3	mm	2014-12-10	<undefined>
SHEET	1 / 1	CORERIVER	